

TEST REPORT

Applicant: Yuneec Technology Co., Limited
Address: Unit 2301, 23/F, 9 Chong Yip Street, Kwun Tong,
Kowloon, Hong Kong
Equipment Type: Radio Transmit Module
Model Name: YUNC201-D
Brand Name: YUNEEC
FCC ID: 2ACS5-H850
ISED Number: 11554B-H850
Test Standard: 47 CFR Part 15 Subpart C
RSS-Gen Issue 5
RSS-247 Issue 2
(refer section 3.1)
Test Date: Mar. 14, 2022 - Jun. 22, 2022
Date of Issue: Jun. 22, 2022

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

**Tested by:** Julie Zhu**Checked by:** Ye Hongji**Approved by:** Liao Jianming
(Technical Director)

Revision History

Version	Issue Date	Revisions
<u>Rev. 01</u>	<u>Jun. 15, 2022</u>	<u>Initial Issue</u>
<u>Rev. 02</u>	<u>Jun. 22, 2022</u>	<u>Update Ground mode channel and update all test data</u>

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1 GENERAL INFORMATION

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China
Phone Number	+86 755 6685 0100

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A.
Description	All measurement facilities used to collect the measurement data are located at Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Yuneec Technology Co., Limited
Address	Unit 2301, 23/F, 9 Chong Yip Street, Kwun Tong, Kowloon, Hong Kong

2.2 Manufacturer Information

Manufacturer	Yuneec International (China) Co., Ltd
Address	No.388 East Zhengwei Road, Jinxi Town, Kunshan, Jiangsu 215324, China

2.3 Factory Information

Factory	Yuneec International (China) Co., Ltd
Address	No.388 East Zhengwei Road, Jinxi Town, Kunshan, Jiangsu 215324, China

2.4 General Description for Equipment under Test (EUT)

EUT Name	Radio Transmit Module
Model Name Under Test	YUNC201-D
Series Model Name	N/A
Description of Model name differentiation	N/A
Serial Number	YUNC201D001
Hardware Version	N/A
Software Version	N/A
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.5 Technical Information

Network and Wireless connectivity	2.4G ISM Band (OFDM modulation)
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The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology	FHSS
Modulation Type	OFDM
Product Type	☒ Mobile ☐ Portable ☐ Fix Location
Transfer Rate	0.25 Mbps
Frequency Range	The frequency range used is 2405 MHz – 2473 MHz; The frequency block is 2400 MHz to 2483.5 MHz.
Number of Channel	18
Nominal Channel Bandwidth	1.4MHz
Tested Channel	Low channel (2405 MHz), Middle channel(2441 MHz), High channel (2473 MHz)
Antenna Type	Dipole Antenna
Antenna Gain	5 dBi (In test items related to antenna gain, the final results reflect this figure. This value is provided by the applicant.)
Adaptive or non-adaptive	non-adaptive
The Max RF Output power	18.45 dBm

Antenna Information:

Antenna Type	Model Name	Antenna Manufacturer	Antenna Gain (dBi)	
			2.4 - 2.5GHz	5.15 - 5.85GHz
Dipole Antenna	5DB External antenna	N/A	5	5

Channel List

Number	Frequency (MHz)	Number	Frequency (MHz)
1	2405(Low)	10	2441(Middle)
2	2409	11	2445
3	2413	12	2449
4	2417	13	2453
5	2421	14	2457
6	2425	15	2461
7	2429	16	2465
8	2433	17	2469
9	2437	18	2473(High)

2.6 Additional Instructions

EUT Software Settings:

Mode	☒ Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.
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During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Test Software Version	Artosyn Test System_4.4.8		
Support Units (Software installation media)	Description	Manufacturer	Model
	Notebook	Lenovo	X220

Mode	Channel	Frequency (MHz)	Soft Set
Ground Mode	Low	2405	8
	Middle	2441	8
	High	2473	8

Run Software:



3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C	Miscellaneous Wireless Communications Services
2	KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules
3	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
4	RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems(FHSs) and Licence-Exemp Local Area Network (LE-LAN) Devices
5	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

3.2 Verdict

No.	Description	FCC Part No.	ISED Part No.	Test Result	Verdict
1	Antenna Requirement	15.203	RSS-247, 5.4 (6)	--	Pass ^{Note 1}
2	Number of Hopping Frequency	15.247(a)	RSS-247, 5.1 (4)	ANNEX A.1	Pass
3	Peak Output Power and E.I.R.P	15.247(b)	RSS-247, 5.4 (2)	ANNEX A.2	Pass
4	Occupied Bandwidth	15.247(a)	RSS-247, 5.1 (1)	ANNEX A.3	Pass
5	Hopping Frequency Separation	15.247(a)	RSS-247, 5.1 (2)	ANNEX A.4	Pass
6	Time of Occupancy (Dwell time)	15.247(a)	RSS-247, 5.1 (4)	ANNEX A.5	Pass
7	Conducted Spurious Emission& Authorized-band band-edge	15.247(d)	RSS-247, 5.5	ANNEX A.6	Pass
8	Conducted Emission	15.207	RSS-GEN, 8.8	ANNEX A.7	Pass
9	Radiated Spurious Emission	15.209 15.247(d)	RSS-247, 5.5	ANNEX A.8	Pass
10	Band Edge (Restricted-band band-edge)	15.209 15.247(d)	RSS-247, 5.5	ANNEX A.9	Pass
11	Receiver Spurious Emissions	--	RSS-Gen, 7.1.2	--	N/A ^{Note 2}

Note ¹: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.

Note ²: Only radio communication receivers operating in stand-alone mode within the band 30-960 MHz, as well as scanner receivers, are subject to Industry Canada requirements, so this test is not applicable.

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	45% to 55%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	20°C to +25°C
Working Voltage of the EUT	NV (Normal Voltage)	5 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-40	101544	2022.01.04	2023.01.03
Spectrum Analyzer	KEYSIGHT	N9020A	MY50330200	2021.06.01	2022.05.31
Spectrum Analyzer	KEYSIGHT	N9020A	MY50330200	2022.05.19	2023.05.18
Signaling Unit	ROHDE&SCHWARZ	CMW500	142028	2021.06.01	2022.05.31
Signaling Unit	ROHDE&SCHWARZ	CMW500	142028	2022.05.19	2023.05.18
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2021.09.13	2022.09.12
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2021.10.10	2022.10.09
LISN	SCHWARZBECK	NSLK 8127	8127-687	2021.06.08	2022.06.07
LISN	SCHWARZBECK	NSLK 8127	8127-687	2022.06.01	2023.05.31
Test Antenna- Loop(9 kHz-30 MHz)	SCHWARZBECK	FMZB 1519	1519-037	2021.04.16	2024.04.15
Test Antenna- Bi-Log(30 MHz-3 GHz)	SCHWARZBECK	VULB 9163	9163-624	2021.08.20	2024.08.19
Test Antenna- Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	9120D-1917	2019.07.02	2022.07.01
Test Antenna- Horn (18-40 GHz)	A-INFO	LB- 180400KF	J211060273	2021.07.02	2024.07.01
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2022.02.19	2024.09.03
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60 *7.35m	N/A	2021.08.15	2024.08.14
Shielded Enclosure	ChangNing	CN-130701	130703	--	--

4.3 Test Software List

Description	Manufacturer	Software Version	Serial No.	Applicable test Setup
BL410R	BALUN	V2.1.1.488	N/A	The section 4.5.1
BL410E	BALUN	V19.8.28.435	N/A	The section 4.5.2&4.5.3&4.5.4&4.5.5

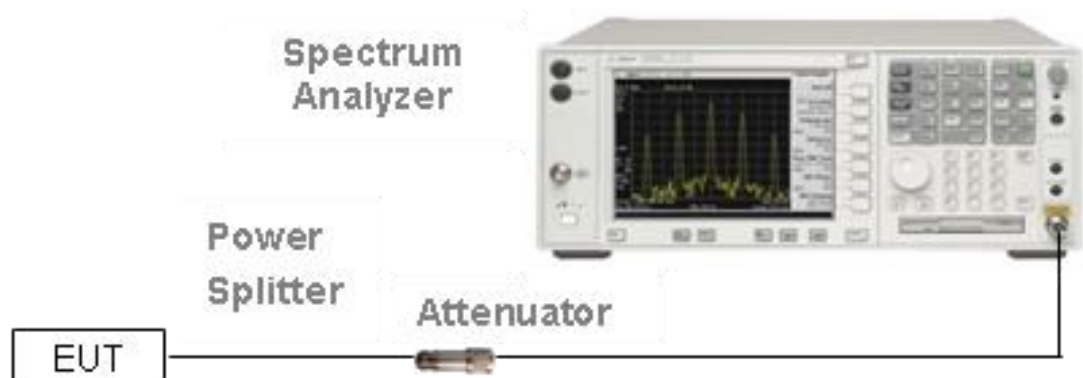
4.4 Description of Test Setup

4.4.1 For Antenna Port Test

Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

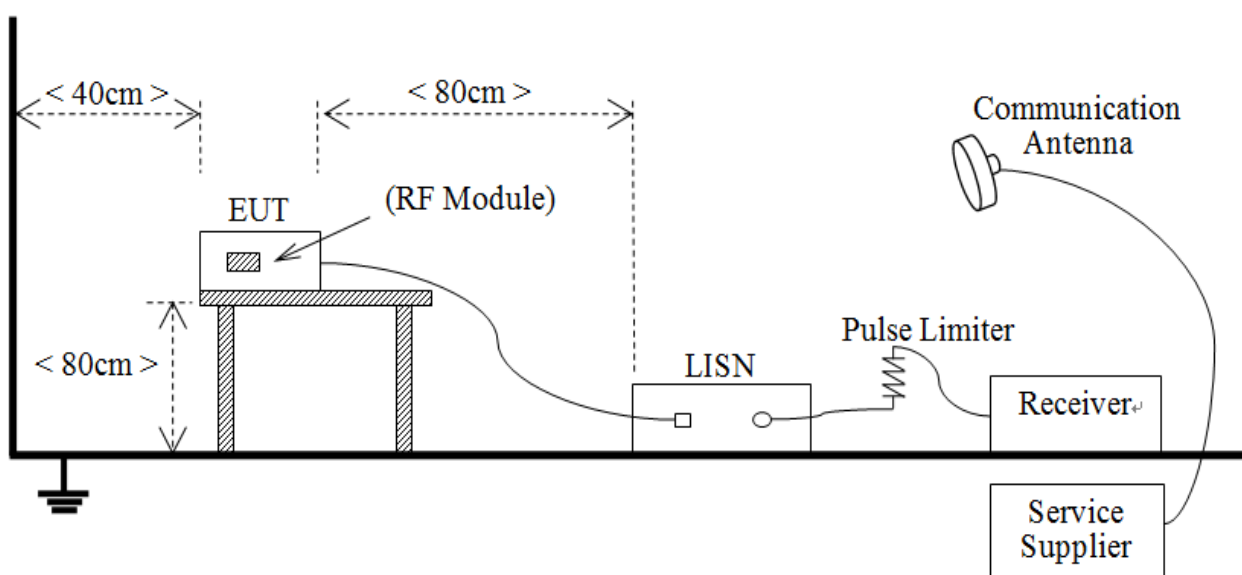
For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:

Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



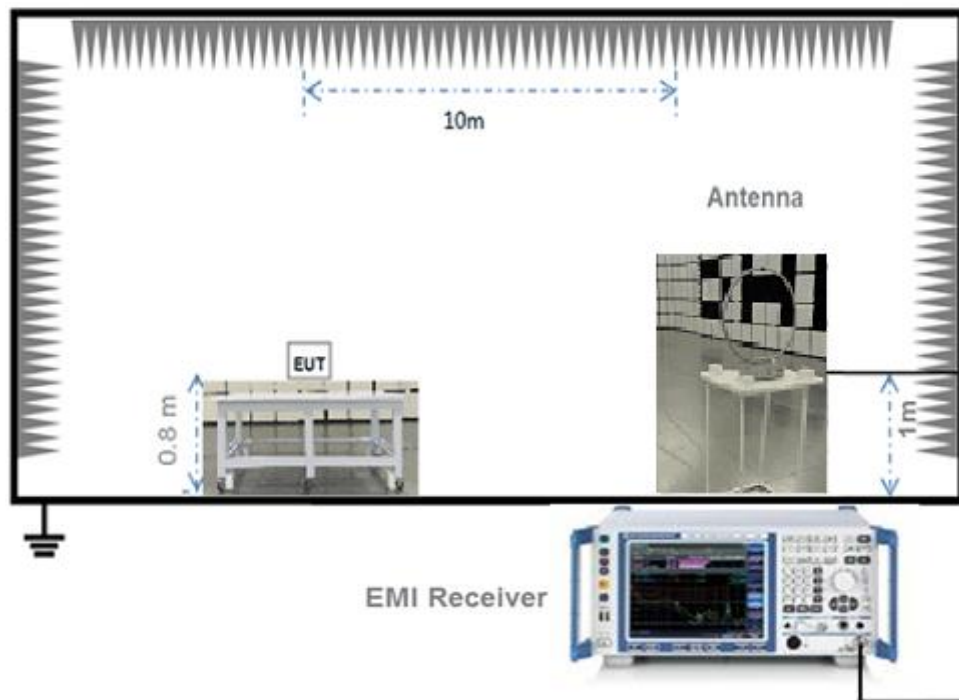
(Diagram 1)

4.4.2 For AC Power Supply Port Test



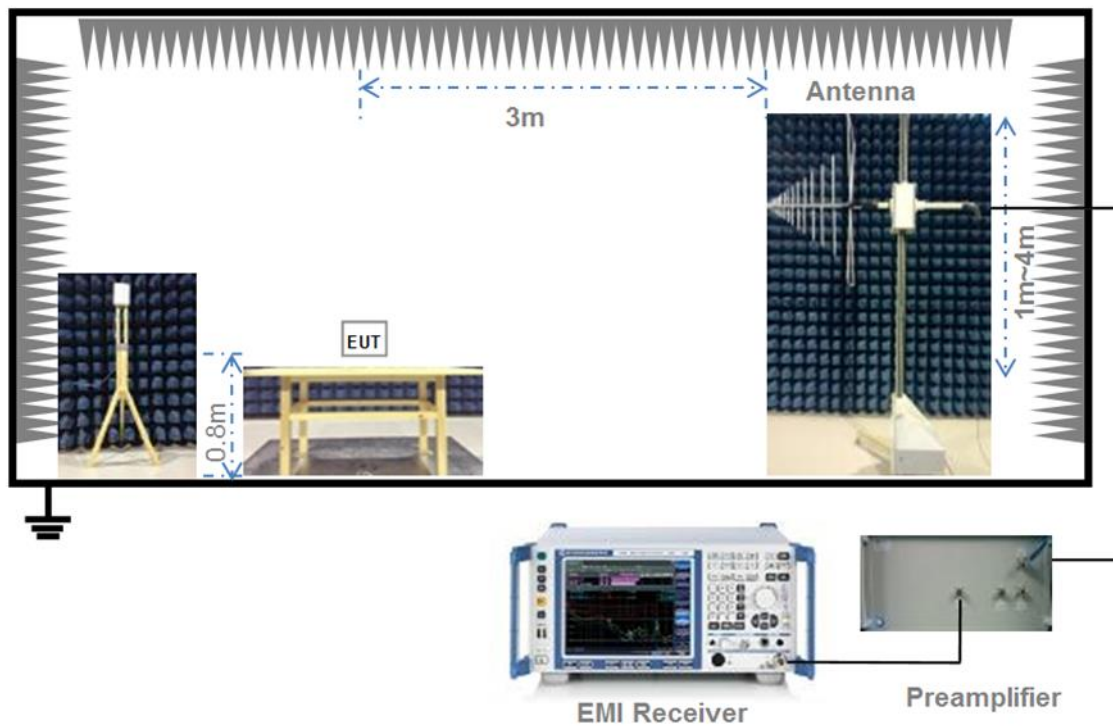
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



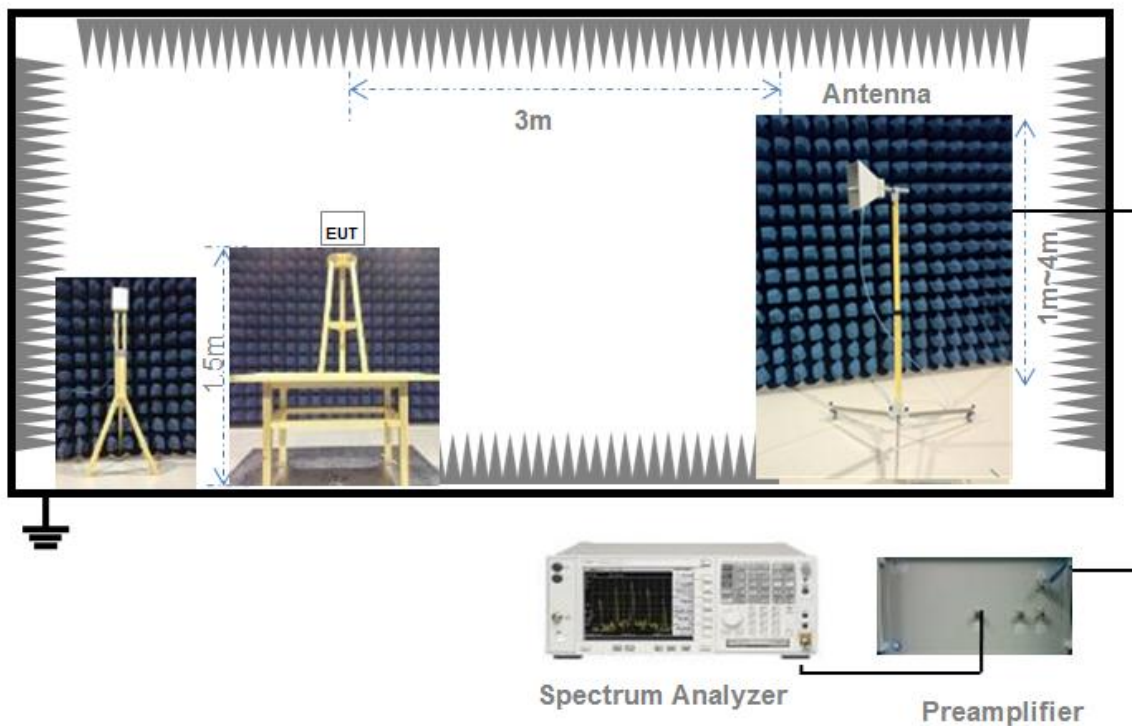
(Diagram 3)

4.4.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.4.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.5 Measurement Results Explanation Example

4.5.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

4.5.2 For radiated band edges and spurious emission test:

Per part 15.35(c), the EUT Bluetooth average emission level could be determined by the peak emission level applying duty cycle correction factor, to represent averaging over the whole pulse train.

The average level is derived from the peak level corrected with "Duty cycle correction factor".

Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + Duty cycle correction factor (dB)

Duty cycle correction factor (dB) = $20 * \log (\text{Duty cycle})$.

Duty cycle = on time / 100 milliseconds

On time = dwell time * hopping number in 100 ms

For example: bluetooth with dwell time 2.9 ms and 3 hops in 100 ms, then

Duty cycle correction factor (dB) = $20 * \log ((2.9 * 3) / 100) = -21.21 \text{ dB}$

Following shows an average computation example with duty cycle correction factor = -21.21 dB, and the peak emission level is 45.61 dBuV/m.

Example:

Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + duty cycle correction factor (dB)
= $45.61 + (-21.21) = 24.4 \text{ (dBuV/m)}$

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Relevant Standards

FCC §15.203 & 15.247(b); RSS-247, 5.4 (6)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is embedded in the product.	The antenna is welded on the mainboard, can't be replaced by the consumer

Reference Documents	Item
Photo	Please refer to the EUT Photo documents.

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Number of Hopping Frequency

5.2.1 Limit

FCC §15.247(a) (1) (iii); RSS-247, 5.1 (4)

Frequency hopping systems operating in the 2400 MHz to 2483.5 MHz bands shall use at least 15 hopping frequencies.

5.2.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW $\geq$ 1% of the span

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Peak Output Power and E.I.R.P

5.3.1 Test Limit

FCC § 15.247(b)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247, 5.4 (2)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

5.3.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Occupied Bandwidth

5.4.1 Limit

FCC §15.247(a); RSS-247, 5.1 (1)

Measurement of the 20dB bandwidth of the modulated signal.

5.4.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW $\geq$ 1% of the 20 dB bandwidth

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Hopping Frequency Separation

5.5.1 Limit

FCC §15.247(a); RSS-247, 5.1 (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

5.5.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) $\geq$ 1% of the span

Video (or Average) Bandwidth (VBW) $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Time of Occupancy (Dwell time)

5.6.1 Limit

FCC §15.247(a); RSS-247, 5.1 (4)

Frequency hopping systems in the 2400 MHz - 2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.6.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

5.6.4 Test Result

Please refer to ANNEX A.5

5.7 Conducted Spurious Emission & Authorized-band band-edge

5.7.1 Limit

FCC §15.247(d); RSS-247, 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.7.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

5.7.4 Test Result

Please refer to ANNEX A.6.

5.8 Conducted Emission

5.8.1 Limit

FCC §15.207; RSS-GEN, 8.8

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dB μ V)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.8.2 Test Setup

See section 4.4.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

5.8.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Radiated Spurious Emission

5.9.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note:

1. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.9.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.9.4 Test Result

Please refer to ANNEX A.8.

5.10 Band Edge (Restricted-band band-edge)

5.10.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.10.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.10.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.10.4 Test Result

Please refer to ANNEX A.9.

ANNEX A TEST RESULT

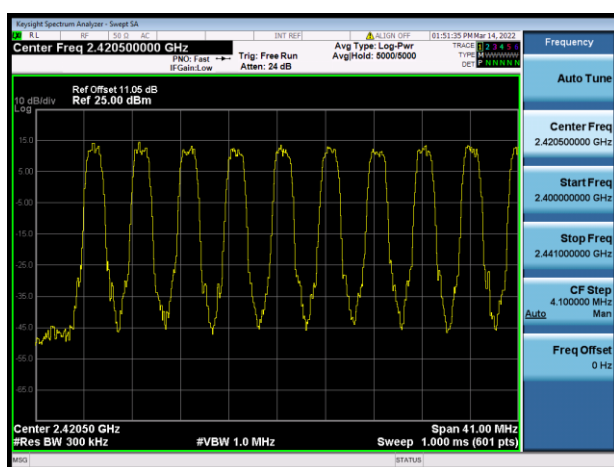
A.1 Number of Hopping Frequency

Test Data

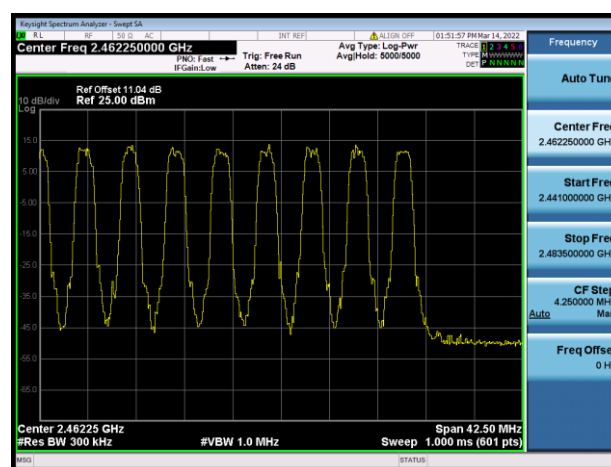
Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Verdict
OFDM	2400 - 2483.5	18	15	Pass

Test plots

OFDM 2.4 GHz ~ 2.4835 GHz



OFDM 2.4 GHz ~ 2.4835 GHz



A.2 Peak Output Power and E.I.R.P

Peak Power Test Data

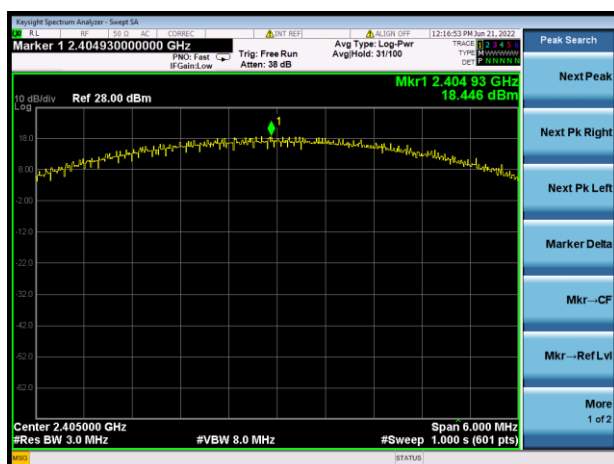
Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
Low	18.45	69.92	21	125	Pass
Middle	16.66	46.37			Pass
High	17.58	57.33			Pass

E.I.R.P Test Data (For ISSED)

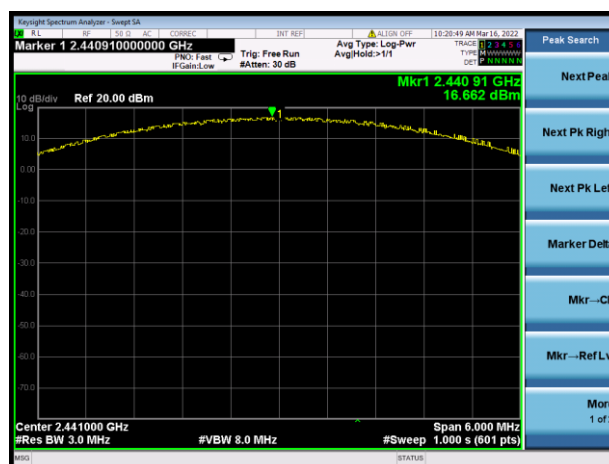
Channel	E.I.R.P		Limit		Verdict
	dBm	mW	dBm	mW	
Low	23.45	221.11	36	4000	Pass
Middle	21.66	146.62			Pass
High	22.58	181.30			Pass

Test plots

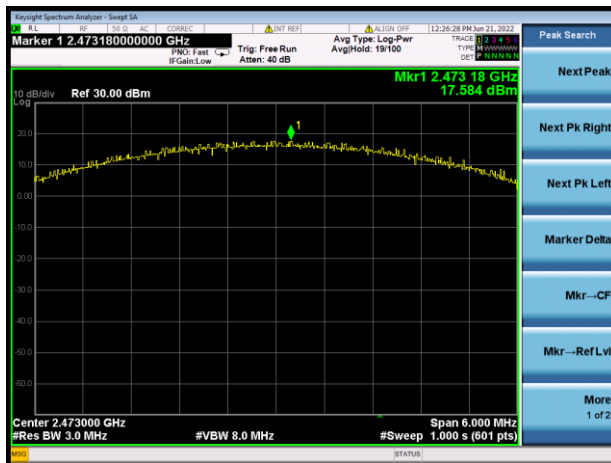
OFDM LOW CHANNEL



OFDM MIDDLE CHANNEL



OFDM HIGH CHANNEL



A.3 Occupied Bandwidth

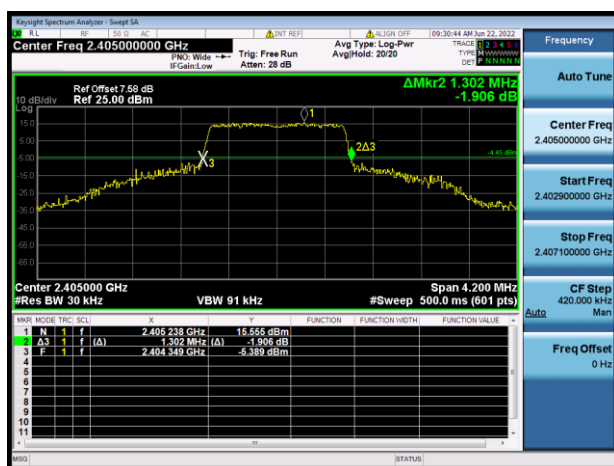
Test Data

Test Mode	OFDM	
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low Channel	1.302000	1.197600
Middle Channel	1.309000	1.191700
High Channel	1.309000	1.192600

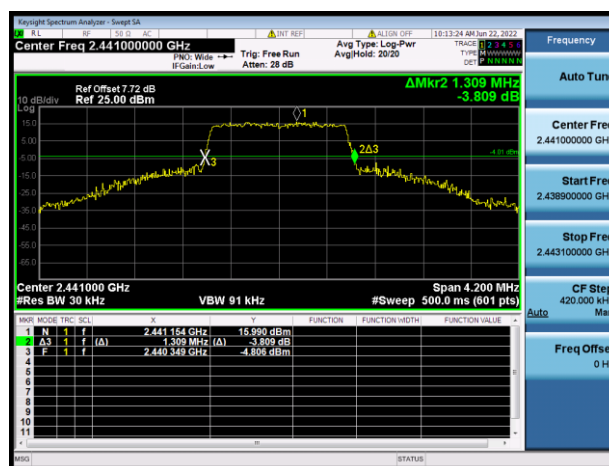
Test plots

20 dB Bandwidth

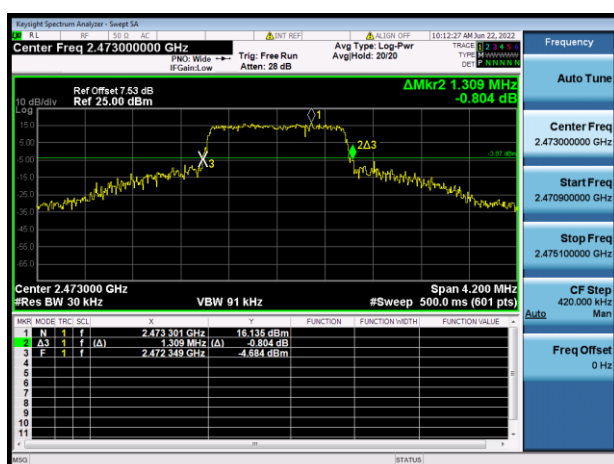
OFDM LOW CHANNEL



OFDM MIDDLE CHANNEL



OFDM HIGH CHANNEL



99% Bandwidth

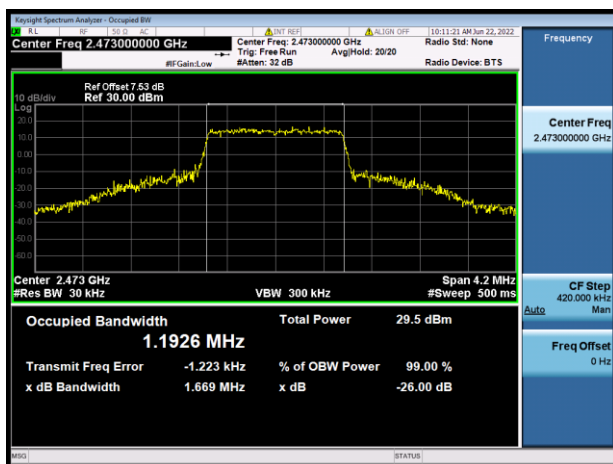
OFDM LOW CHANNEL



OFDM MIDDLE CHANNEL



OFDM HIGH CHANNEL



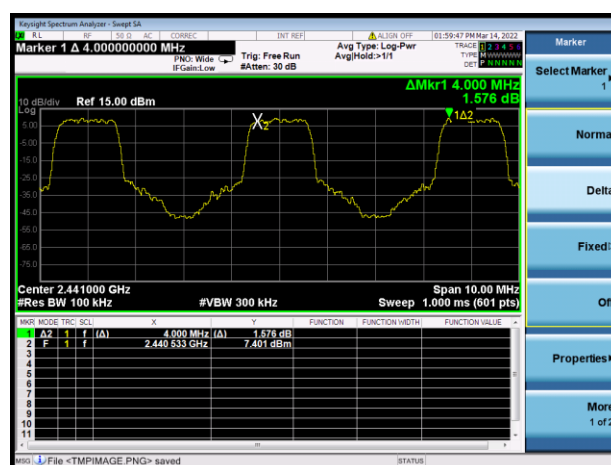
A.4 Hopping Frequency Separation

Test Data

Mode	Frequency separation (MHz)	2/3 of the 20 dB Bandwidth (MHz)	Verdict
OFDM	4.000	0.873	Pass

Test Plots

OFDM



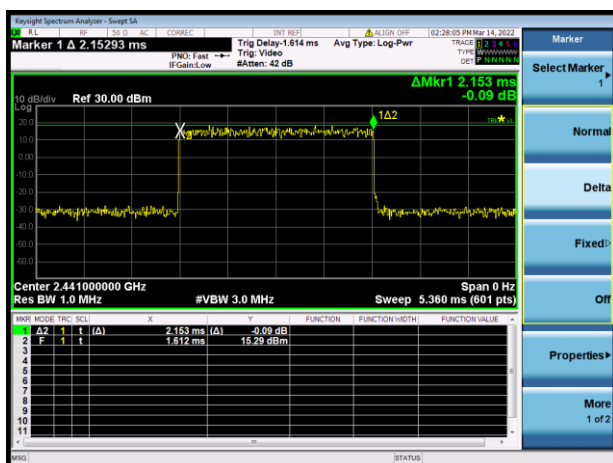
A.5 Time of Occupancy (Dwell time)

Test Data

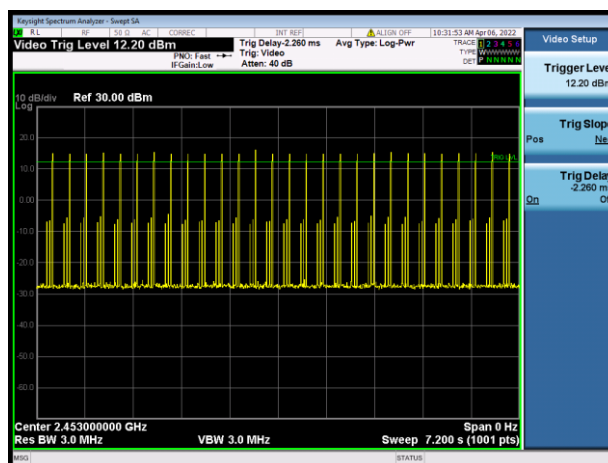
OFDM			
Pulse Width (ms)	Total of Dwell (ms)	Limit (sec)	Verdict
2.15300	60.284	0.4	Pass

Test Plots

5.36ms



7.2s



A.6 Conducted Spurious Emissions & Authorized-band band-edge

Test Data

OFDM Mode:

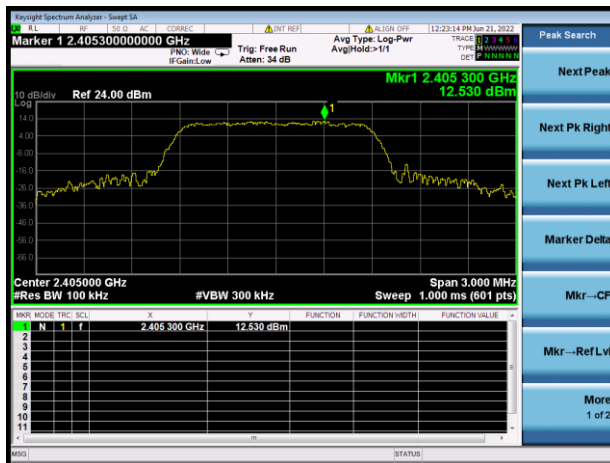
OFDM				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-32.22	12.53	-7.47	Pass
Middle	-27.72	13.03	-6.97	Pass
High	-27.40	11.12	-8.88	Pass

Hopping Mode:

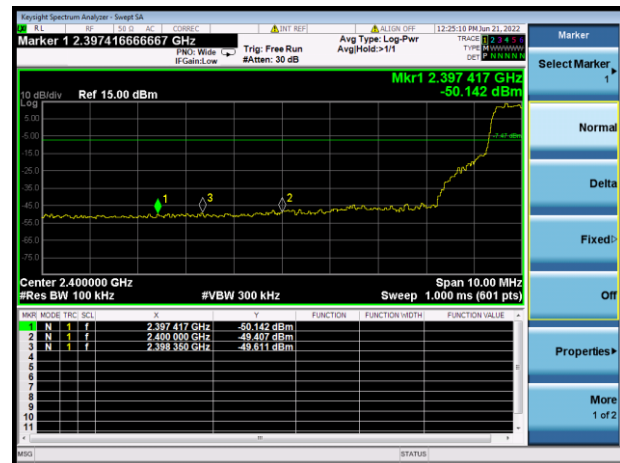
OFDM				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
OFDM	-34.64	9.66	-10.34	Pass

Test Plots

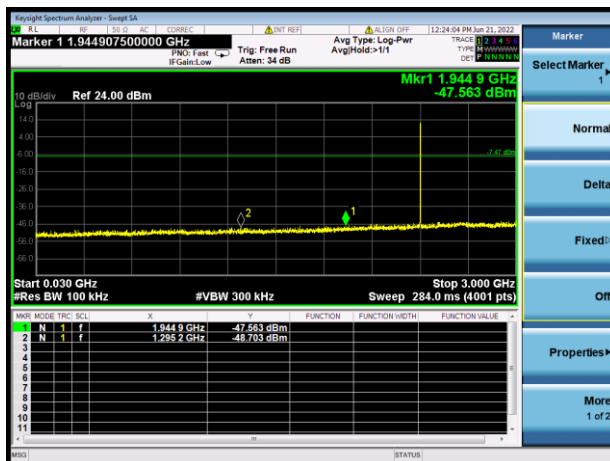
OFDM LOW CHANNEL, CARRIER LEVEL



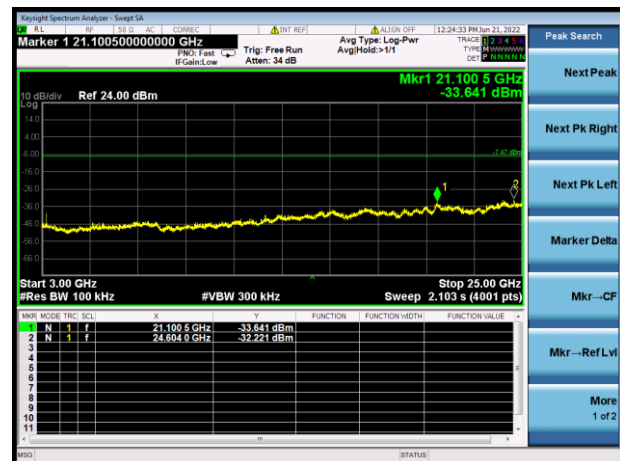
OFDM LOW CHANNEL, BAND EDGE



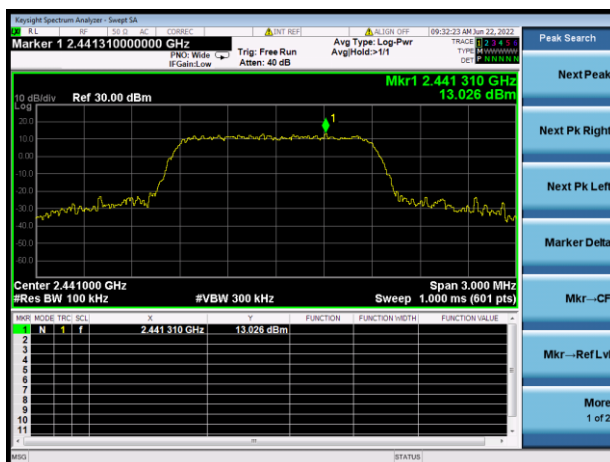
OFDM LOW CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



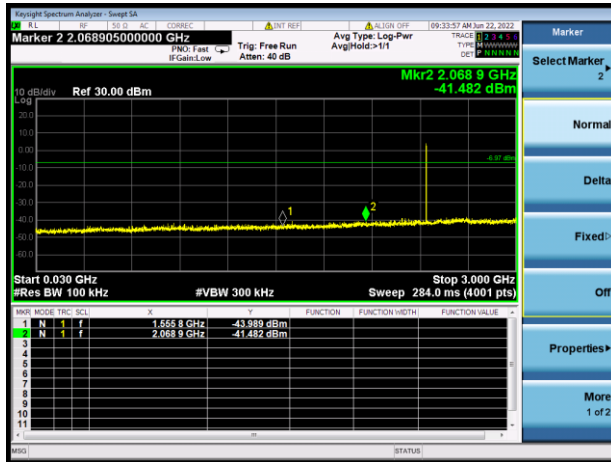
OFDM LOW CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



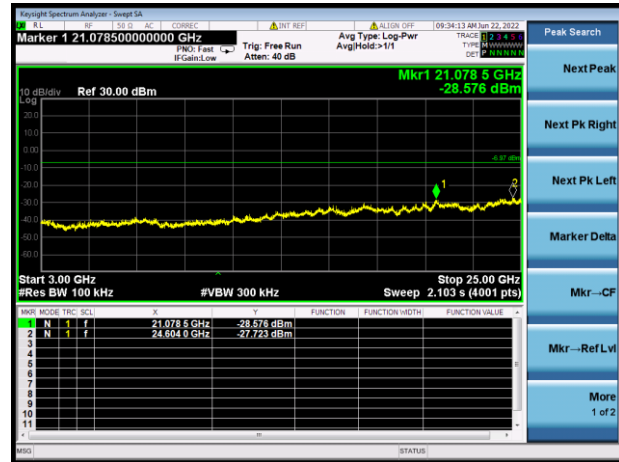
OFDM MIDDLE CHANNEL, CARRIER LEVEL



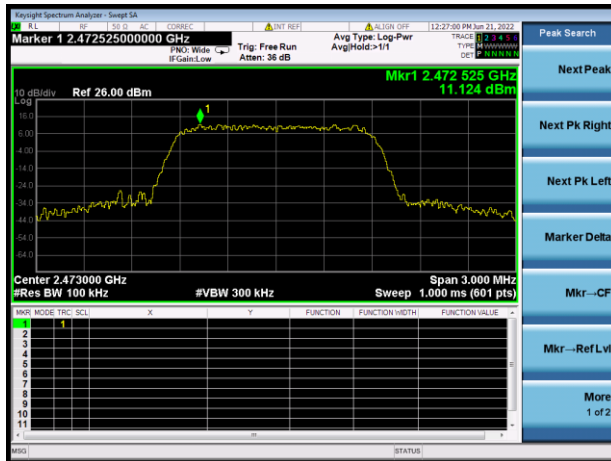
OFDM MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



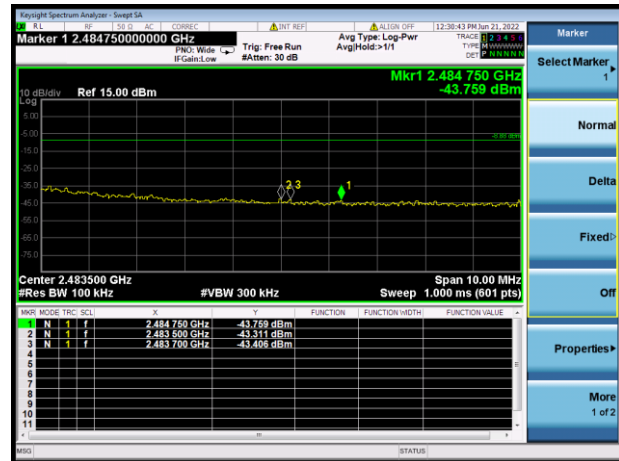
OFDM MIDDLE CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



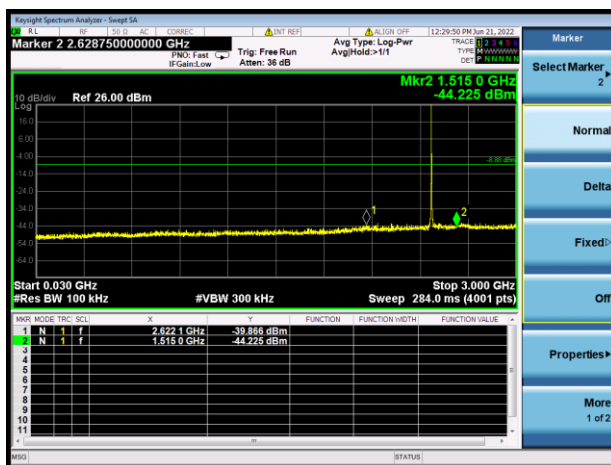
OFDM HIGH CHANNEL, CARRIER LEVEL



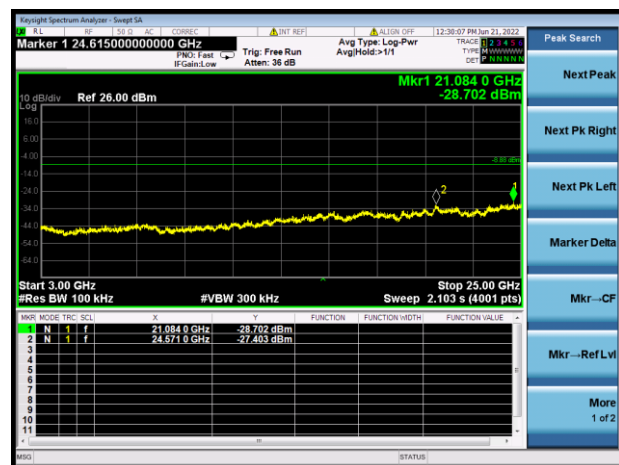
OFDM HIGH CHANNEL, BAND EDGE



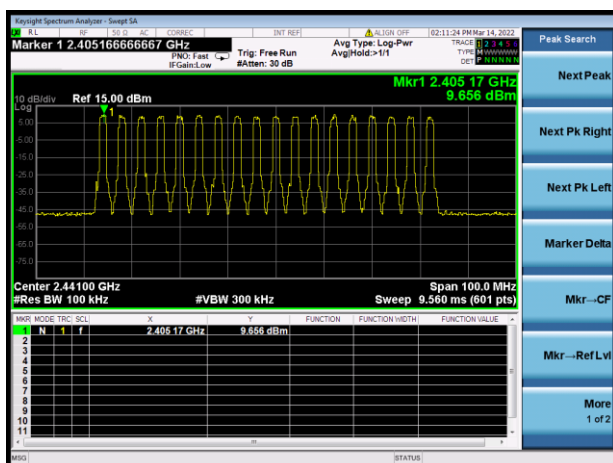
OFDM HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



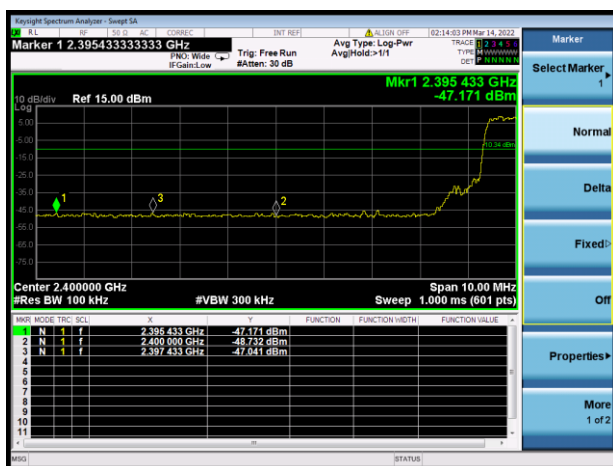
OFDM HIGH CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



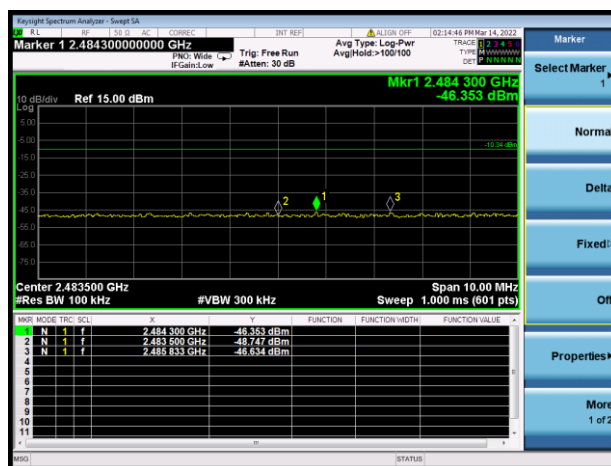
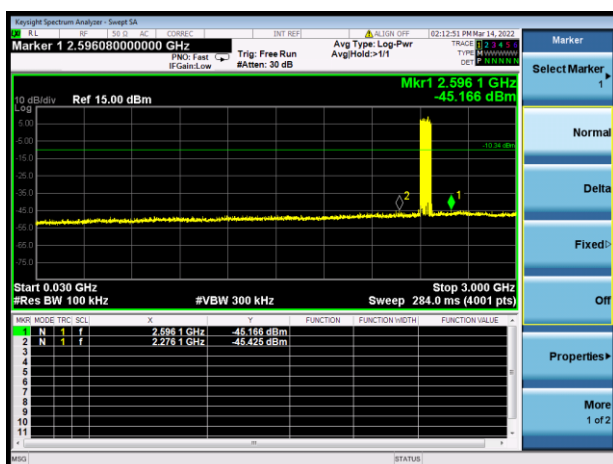
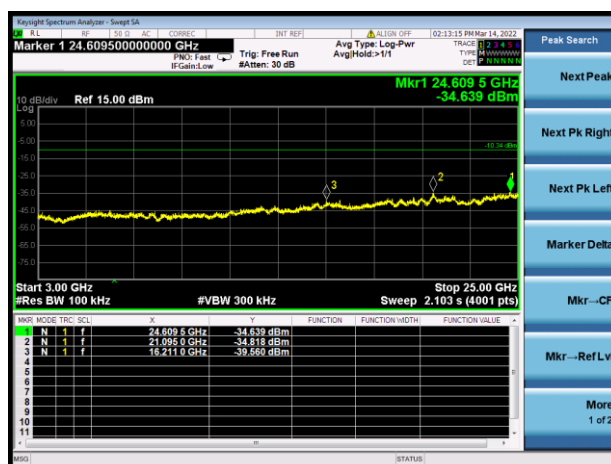
OFDM HOPPING, CARRIER LEVEL



OFDM HOPPING BAND EDGE (LOW)



OFDM HOPPING BAND EDGE (HIGH)

OFDM Hopping Mode, SPURIOUS
30 MHz ~ 3 GHzOFDM Hopping Mode, SPURIOUS
3GHz ~ 25 GHz

A.7 Conducted Emissions

Note ¹: The EUT is working in the Normal link mode. All modes have been tested and normal link mode is worst.

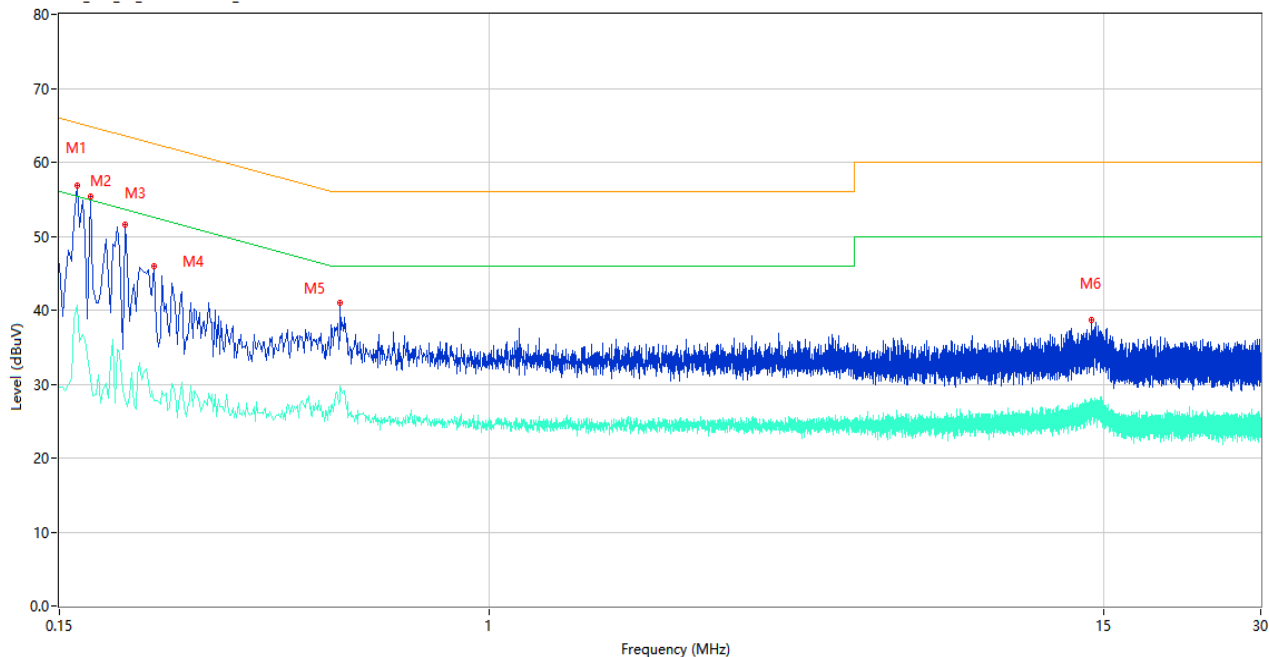
Note ²: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 60 Hz and 240 VAC, 50 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz) shown here.

Note ³: Results (dBuV) = Original reading level of Spectrum Analyzer (dBuV) + Factor (dB)

Test Data and Plots

PHASE L

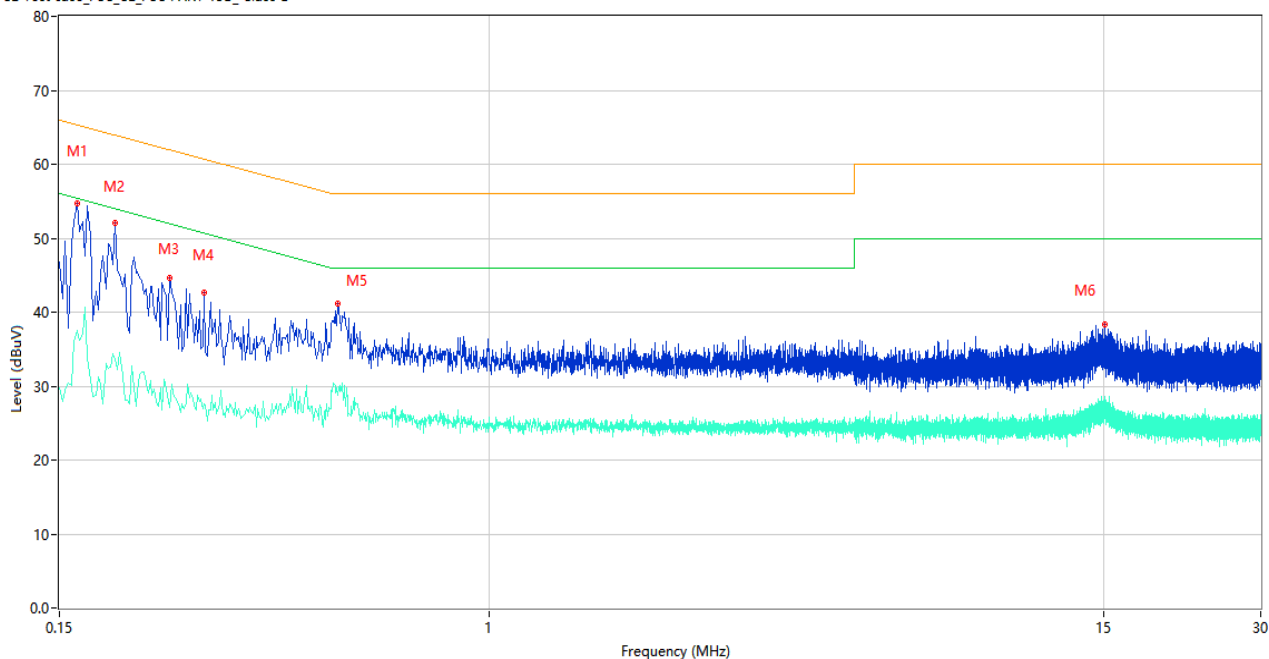
CE Test case_FCC_CE_FCC PART 15B_Class B



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.162	56.78	10.99	65.36	-8.58	Peak	L	Pass
1**	0.162	40.58	10.99	55.36	-14.78	AV	L	Pass
2	0.172	55.42	10.98	64.86	-9.44	Peak	L	Pass
2**	0.172	30.82	10.98	54.86	-24.04	AV	L	Pass
3	0.200	51.49	10.96	63.61	-12.12	Peak	L	Pass
3**	0.200	28.00	10.96	53.61	-25.61	AV	L	Pass
4	0.228	46.02	10.94	62.52	-16.50	Peak	L	Pass
4**	0.228	27.81	10.94	52.52	-24.71	AV	L	Pass
5	0.518	40.91	10.91	56.00	-15.09	Peak	L	Pass
5**	0.518	29.81	10.91	46.00	-16.19	AV	L	Pass
6	14.230	38.69	10.66	60.00	-21.31	Peak	L	Pass
6**	14.230	26.61	10.66	50.00	-23.39	AV	L	Pass

PHASE N

CE Test case_FCC_CE_FCC PART 15B_ Class B



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.162	54.73	10.99	65.36	-10.63	Peak	N	Pass
1**	0.162	37.45	10.99	55.36	-17.91	AV	N	Pass
2	0.192	52.09	10.96	63.95	-11.86	Peak	N	Pass
2**	0.192	33.71	10.96	53.95	-20.24	AV	N	Pass
3	0.244	44.56	10.92	61.96	-17.40	Peak	N	Pass
3**	0.244	27.14	10.92	51.96	-24.82	AV	N	Pass
4	0.284	42.70	10.89	60.70	-18.00	Peak	N	Pass
4**	0.284	27.58	10.89	50.70	-23.12	AV	N	Pass
5	0.512	41.14	10.92	56.00	-14.86	Peak	N	Pass
5**	0.512	28.78	10.92	46.00	-17.22	AV	N	Pass
6	15.086	38.31	10.59	60.00	-21.69	Peak	N	Pass
6**	15.086	26.71	10.59	50.00	-23.29	AV	N	Pass

A.8 Radiated Emission

Test Data and Plots

Note ¹: The symbol of "--" in the table which means not application.

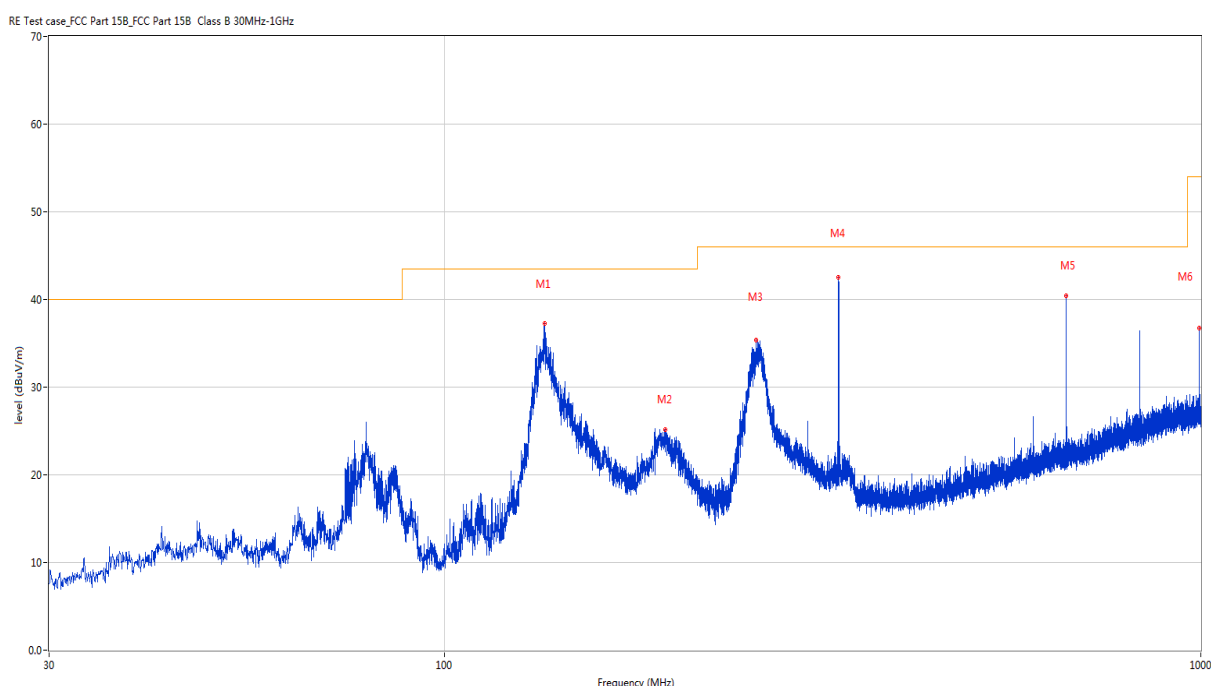
Note ²: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note ³: The EUT is working in the Normal link mode below 1 GHz. All modes have been tested and DH5-Hopping mode is the worst.

Note ⁴: Results (dBuV/m) = Original reading level of Spectrum Analyzer (dBuV/m) + Factor (dB)

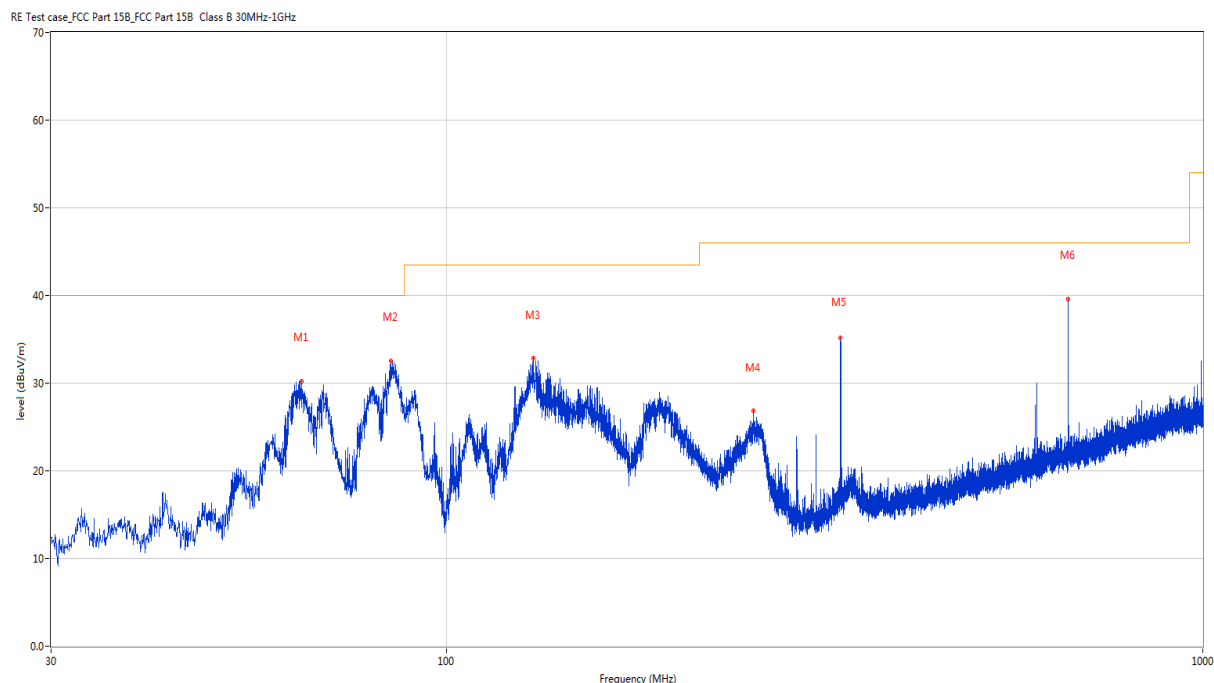
The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

30 MHz to 1 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	135.584	37.25	-27.47	43.5	-6.25	Peak	221.10	200	Horizontal	Pass
2	195.628	25.13	-24.37	43.5	-18.37	Peak	71.50	100	Horizontal	Pass
3	258.095	35.32	-22.75	46.0	-10.68	Peak	213.10	100	Horizontal	Pass
4	332.010	42.51	-20.66	46.0	-3.49	Peak	217.90	100	Horizontal	Pass
5	663.992	38.89	-13.79	46.0	-7.11	Peak	151.30	100	Horizontal	Pass
6	996.023	36.73	-9.11	54.0	-17.27	Peak	236.40	100	Horizontal	Pass

30 MHz to 1 GHz, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	64.338	30.24	-24.97	40.0	-9.76	Peak	206.40	100	Vertical	Pass
2	84.368	32.48	-27.72	40.0	-7.52	Peak	354.10	100	Vertical	Pass
3	130.395	32.79	-27.09	43.5	-10.71	Peak	220.80	100	Vertical	Pass
4	254.555	26.83	-22.63	46.0	-19.17	Peak	216.10	100	Vertical	Pass
5	332.010	35.19	-20.66	46.0	-10.81	Peak	32.30	100	Vertical	Pass
6	663.992	39.61	-13.79	46.0	-6.39	Peak	245.20	100	Vertical	Pass

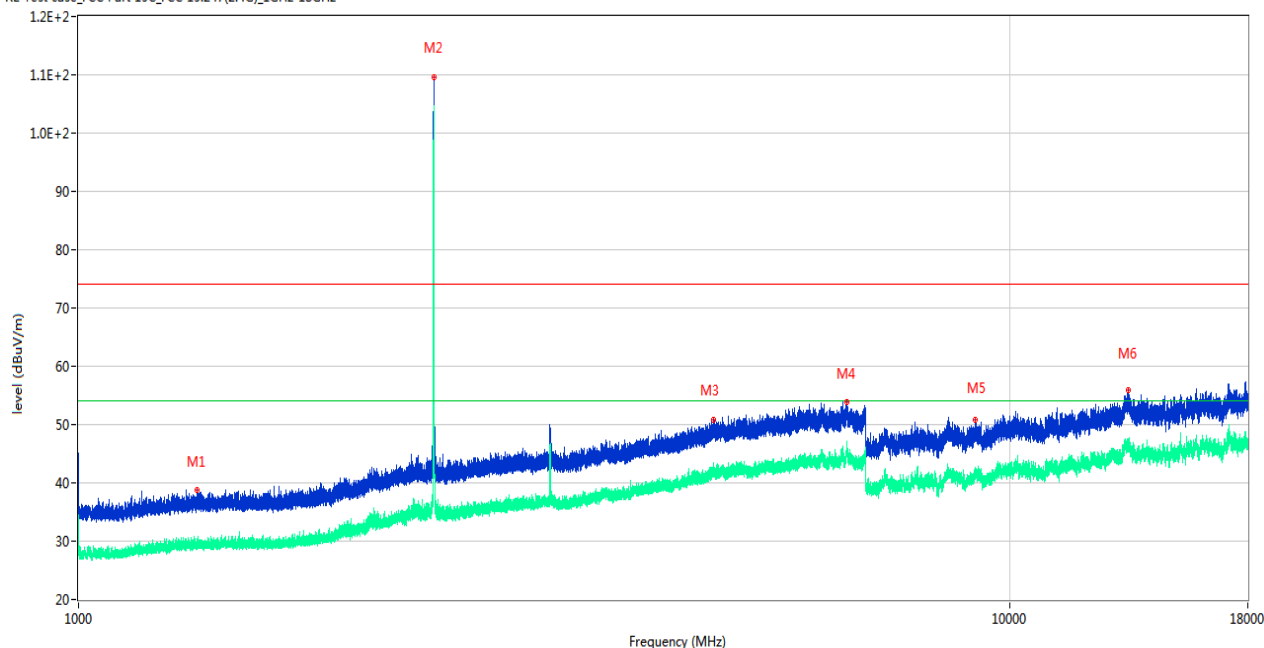
Test Data and Plots (1 GHz ~ 10th Harmonic)

Note 1: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.

Note 2: The spurious from 18GHz-25GHz is noise only, do not show on the report.

OFDM LOW CHANNEL 1 GHz to 18 GHz, ANT H

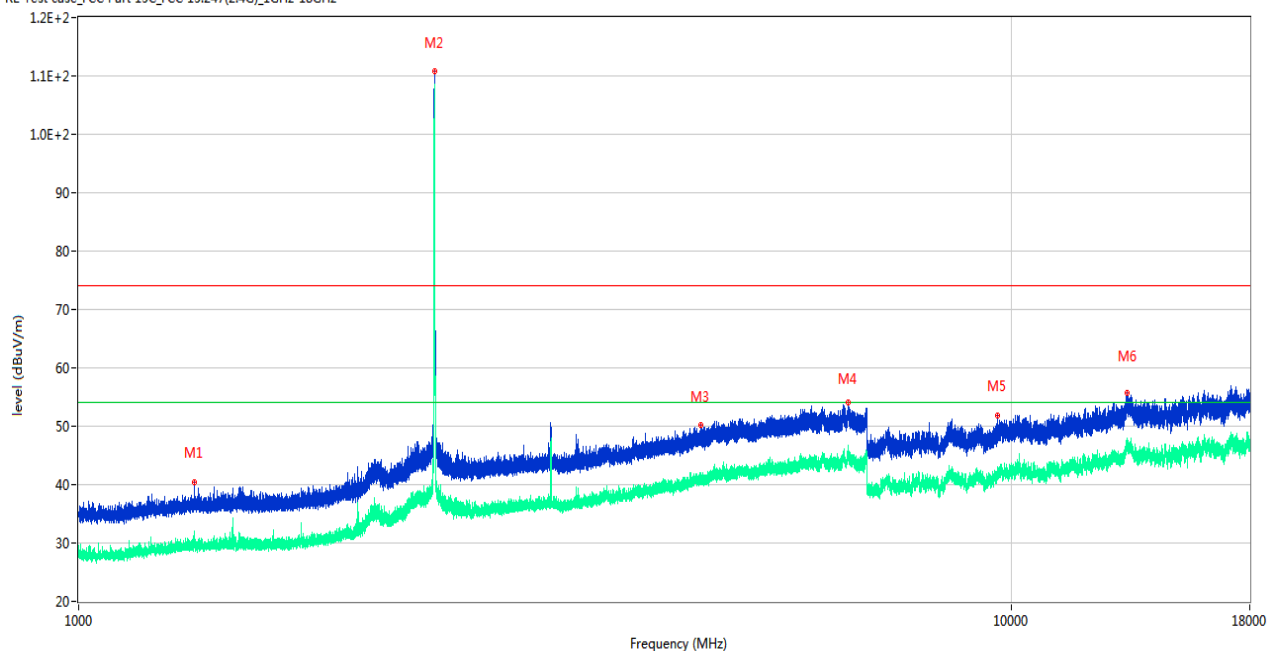
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1341.900	38.71	-17.47	74.0	-36.21	Peak	69.00	150	Horizontal	Pass
1**	1341.900	29.94	-17.47	54.0	-24.34	AV	69.00	150	Horizontal	Pass
2	2404.900	109.60	-12.32	74.0	35.95	Peak	336.00	150	Horizontal	N/A
2**	2404.900	103.04	-12.32	54.0	49.29	AV	336.00	150	Horizontal	N/A
3	4800.000	50.81	-2.56	74.0	-23.91	Peak	164.00	150	Horizontal	Pass
3**	4800.000	43.10	-2.56	54.0	-11.19	AV	164.00	150	Horizontal	Pass
4	6682.000	53.90	-0.38	74.0	-20.16	Peak	67.00	150	Horizontal	Pass
4**	6682.000	45.11	-0.38	54.0	-9.34	AV	67.00	150	Horizontal	Pass
5	9181.687	50.77	-1.32	74.0	-23.32	Peak	210.00	150	Horizontal	Pass
5**	9181.687	41.51	-1.32	54.0	-13.46	AV	210.00	150	Horizontal	Pass
6	13401.037	55.88	0.53	74.0	-17.39	Peak	0.00	150	Horizontal	Pass
6**	13401.037	46.61	0.53	54.0	-7.96	AV	0.00	150	Horizontal	Pass

OFDM LOW CHANNEL 1 GHz to 18 GHz, ANT V

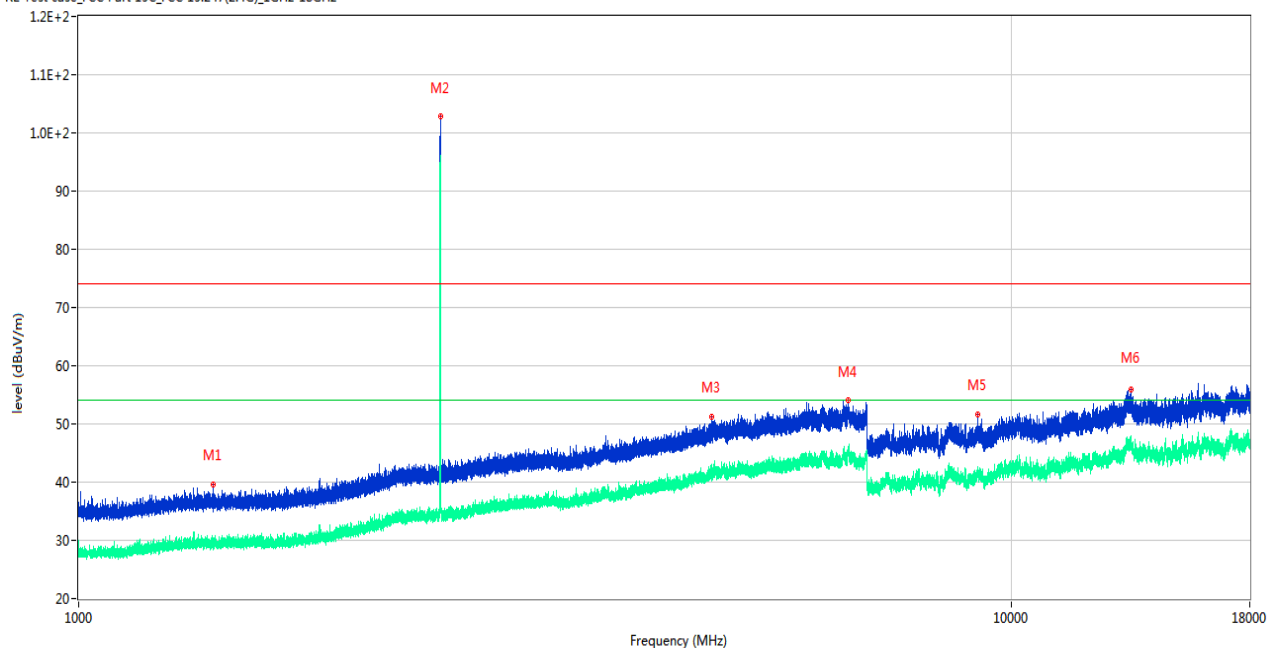
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1329.800	40.31	-17.42	74.0	-33.26	Peak	118.00	150	Vertical	Pass
1**	1329.800	30.08	-17.42	54.0	-24.37	AV	118.00	150	Vertical	Pass
2	2405.600	110.82	-12.32	74.0	36.97	Peak	244.00	150	Vertical	N/A
2**	2405.600	107.54	-12.32	54.0	53.55	AV	244.00	150	Vertical	N/A
3	4643.200	50.17	-3.55	74.0	-24.08	Peak	152.00	150	Vertical	Pass
3**	4643.200	40.97	-3.55	54.0	-13.01	AV	152.00	150	Vertical	Pass
4	6688.200	54.09	-0.25	74.0	-19.17	Peak	360.00	150	Vertical	Pass
4**	6688.200	44.43	-0.25	54.0	-9.46	AV	360.00	150	Vertical	Pass
5	9660.812	51.85	-0.10	74.0	-22.5	Peak	286.00	150	Vertical	Pass
5**	9660.812	42.08	-0.10	54.0	-11.8	AV	286.00	150	Vertical	Pass
6	13296.525	55.71	0.84	74.0	-18.18	Peak	323.00	150	Vertical	Pass
6**	13296.525	45.98	0.84	54.0	-7.11	AV	323.00	150	Vertical	Pass

OFDM MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

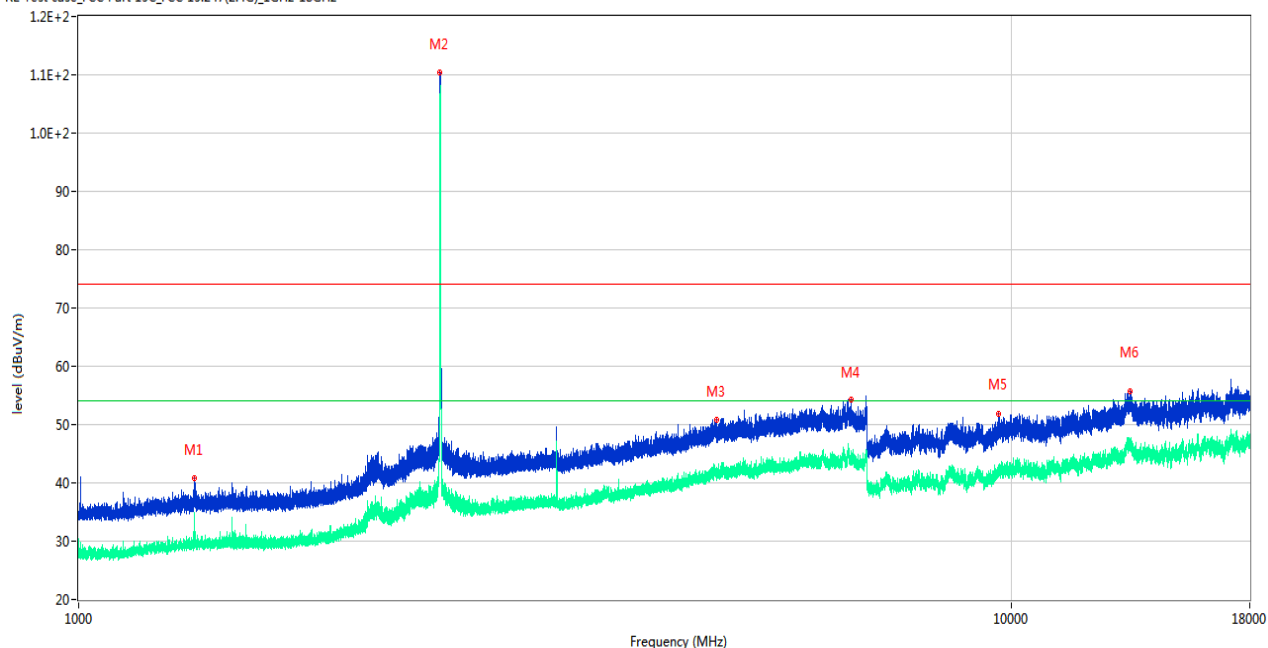
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1394.300	39.68	-17.58	74.0	-33.45	Peak	118.00	150	Horizontal	Pass
1**	1394.300	29.00	-17.58	54.0	-24.41	AV	118.00	150	Horizontal	Pass
2	2441.100	102.79	-12.83	74.0	29.78	Peak	244.00	150	Horizontal	N/A
2**	2441.100	94.62	-12.83	54.0	40.02	AV	244.00	150	Horizontal	N/A
3	4771.800	51.24	-3.01	74.0	-22.68	Peak	152.00	150	Horizontal	Pass
3**	4771.800	41.10	-3.01	54.0	-12.39	AV	152.00	150	Horizontal	Pass
4	6686.600	54.10	-0.21	74.0	-19.48	Peak	360.00	150	Horizontal	Pass
4**	6686.600	45.38	-0.21	54.0	-8.54	AV	360.00	150	Horizontal	Pass
5	9203.974	51.61	-1.29	74.0	-22.63	Peak	286.00	150	Horizontal	Pass
5**	9203.974	41.09	-1.29	54.0	-12.94	AV	286.00	150	Horizontal	Pass
6	13426.463	55.86	0.40	74.0	-18.49	Peak	323.00	150	Horizontal	Pass
6**	13426.463	45.90	0.40	54.0	-8.85	AV	323.00	150	Horizontal	Pass

OFDM MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

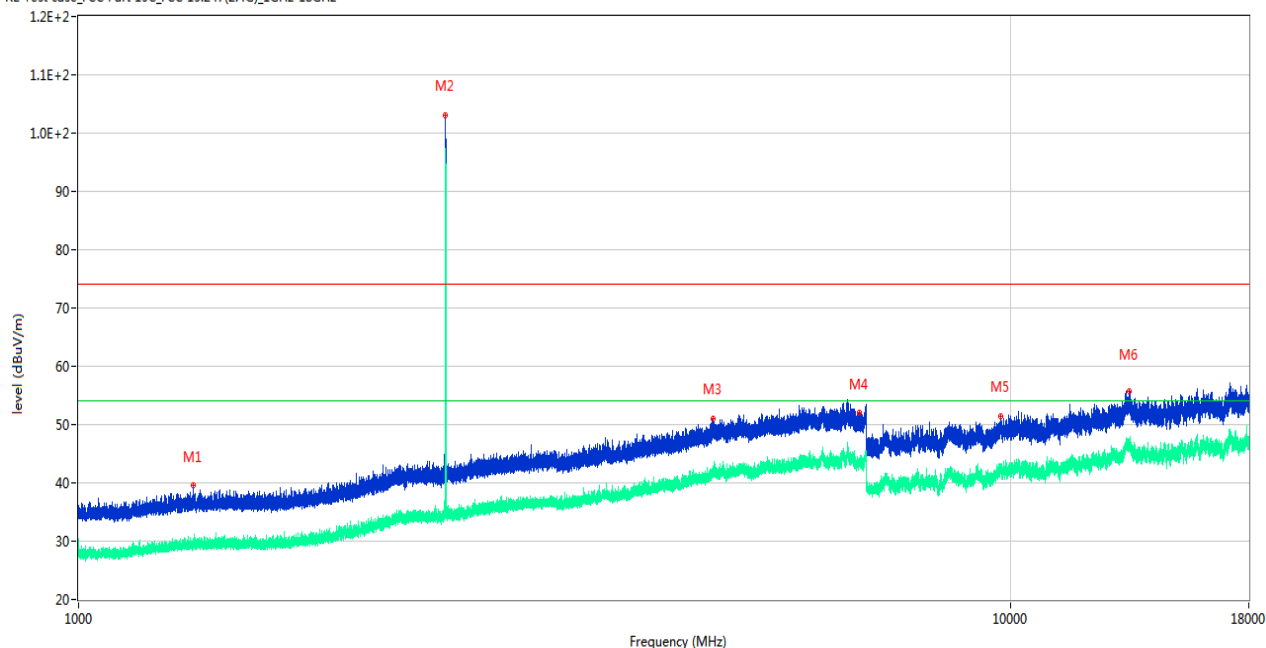
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1329.200	40.72	-17.44	74.0	-32.6	Peak	69.00	150	Vertical	Pass
1**	1329.200	33.41	-17.44	54.0	-19.83	AV	69.00	150	Vertical	Pass
2	2440.600	110.37	-12.76	74.0	36.28	Peak	336.00	150	Vertical	N/A
2**	2440.600	106.21	-12.76	54.0	52.01	AV	336.00	150	Vertical	N/A
3	4822.800	50.78	-3.41	74.0	-23.98	Peak	164.00	150	Vertical	Pass
3**	4822.800	42.43	-3.41	54.0	-10.97	AV	164.00	150	Vertical	Pass
4	6726.000	54.34	-0.90	74.0	-18.94	Peak	67.00	150	Vertical	Pass
4**	6726.000	43.41	-0.90	54.0	-10.37	AV	67.00	150	Vertical	Pass
5	9679.213	51.81	0.16	74.0	-21.77	Peak	210.00	150	Vertical	Pass
5**	9679.213	43.01	0.16	54.0	-10.48	AV	210.00	150	Vertical	Pass
6	13410.713	55.62	0.49	74.0	-19.19	Peak	0.00	150	Vertical	Pass
6**	13410.713	47.32	0.49	54.0	-7.5	AV	0.00	150	Vertical	Pass

OFDM HIGH CHANNEL 1 GHz to 18 GHz, ANT H

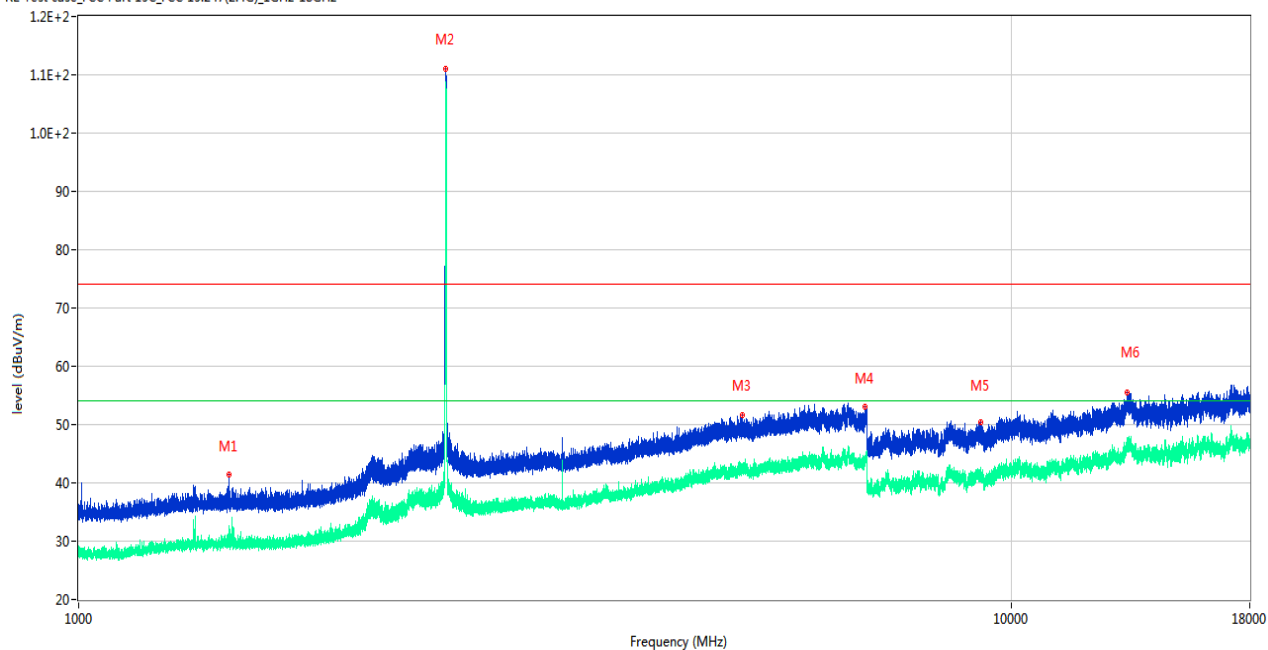
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1328.500	39.51	-17.47	74.0	-35.36	Peak	286.00	150	Horizontal	Pass
1**	1328.500	29.40	-17.47	54.0	-24.72	AV	286.00	150	Horizontal	Pass
2	2472.900	103.06	-12.38	74.0	28.78	Peak	94.00	150	Horizontal	N/A
2**	2472.900	94.71	-12.38	54.0	40.65	AV	94.00	150	Horizontal	N/A
3	4792.800	51.00	-2.66	74.0	-22	Peak	1.00	150	Horizontal	Pass
3**	4792.800	42.10	-2.66	54.0	-12.66	AV	1.00	150	Horizontal	Pass
4	6880.600	52.02	-1.40	74.0	-22.72	Peak	47.00	150	Horizontal	Pass
4**	6880.600	42.81	-1.40	54.0	-11.54	AV	47.00	150	Horizontal	Pass
5	9742.463	51.44	-0.54	74.0	-23.19	Peak	104.00	150	Horizontal	Pass
5**	9742.463	42.37	-0.54	54.0	-12.39	AV	104.00	150	Horizontal	Pass
6	13384.463	55.81	0.63	74.0	-18.76	Peak	30.00	150	Horizontal	Pass
6**	13384.463	45.97	0.63	54.0	-7.92	AV	30.00	150	Horizontal	Pass

OFDM HIGH CHANNEL 1 GHz to 18 GHz, ANT V

RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1450.600	41.43	-17.35	74.0	-31.72	Peak	286.00	150	Vertical	Pass
1**	1450.600	29.39	-17.35	54.0	-24.46	AV	286.00	150	Vertical	Pass
2	2473.100	111.05	-12.38	74.0	37.48	Peak	194.00	150	Vertical	N/A
2**	2473.100	108.23	-12.38	54.0	54.06	AV	194.00	150	Vertical	N/A
3	5142.000	51.66	-2.48	74.0	-21.73	Peak	1.00	150	Vertical	Pass
3**	5142.000	43.08	-2.48	54.0	-10.4	AV	1.00	150	Vertical	Pass
4	6971.000	53.06	0.66	74.0	-21.23	Peak	247.00	150	Vertical	Pass
4**	6971.000	44.04	0.66	54.0	-10.83	AV	247.00	150	Vertical	Pass
5	9258.313	50.38	-1.31	74.0	-23.96	Peak	104.00	150	Vertical	Pass
5**	9258.313	41.22	-1.31	54.0	-12.31	AV	104.00	150	Vertical	Pass
6	13283.662	55.48	0.74	74.0	-19.16	Peak	360.00	150	Vertical	Pass
6**	13283.662	45.73	0.74	54.0	-8.12	AV	360.00	150	Vertical	Pass

A.9 Band Edge (Restricted-band band-edge)

Note ¹: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

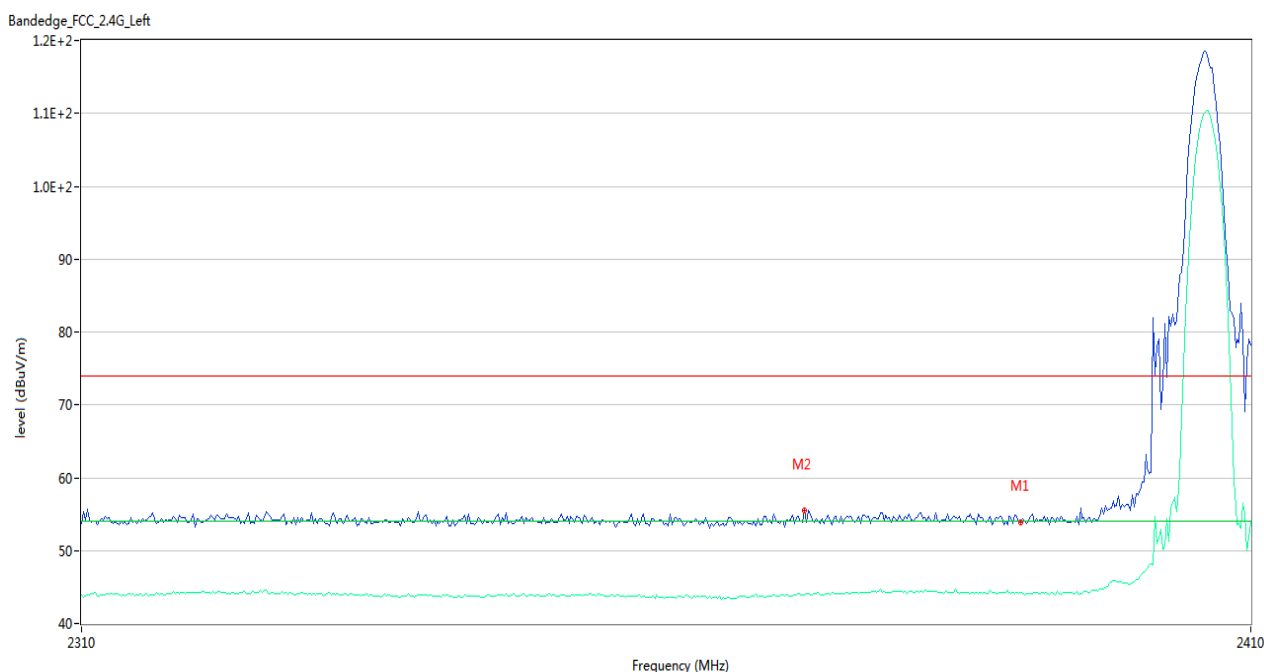
Note ²: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

Note ³: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note ⁴: The Level (dBuV/m) has been corrected by factor.

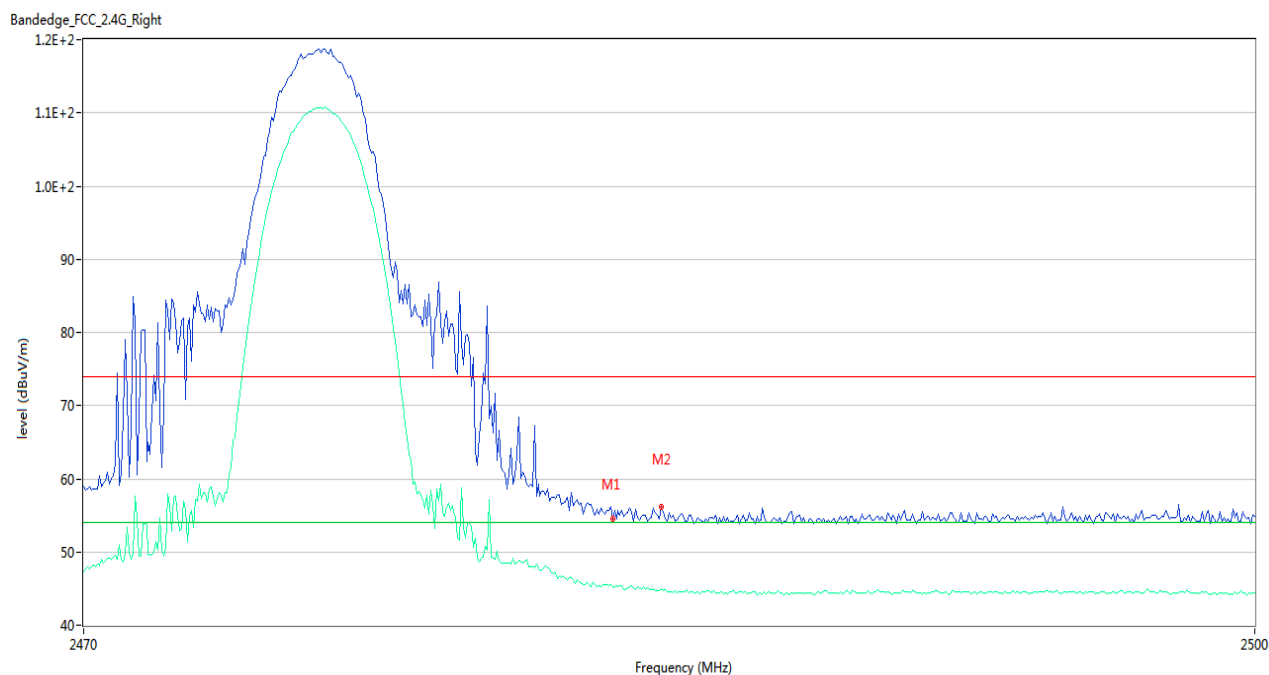
Test Data

OFDM LOW CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2390.000	53.83	-0.50	74.0	-20.17	Peak	162.00	150	Vertical	Pass
1**	2390.000	44.80	-0.50	54.0	-9.20	AV	162.00	150	Vertical	Pass
2	2371.333	55.87	-0.46	74.0	-18.13	Peak	142.00	150	Vertical	Pass
2**	2371.333	43.72	-0.46	54.0	-10.28	AV	142.00	150	Vertical	Pass

OFDM HIGH CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.500	54.79	-0.36	74.0	-19.21	Peak	8.00	150	Vertical	Pass
1**	2483.500	45.30	-0.36	54.0	-8.70	AV	8.00	150	Vertical	Pass
2	2484.650	56.60	-0.34	74.0	-17.40	Peak	12.00	150	Vertical	Pass
2**	2484.650	45.03	-0.34	54.0	-8.97	AV	12.00	150	Vertical	Pass

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-EC2220046-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-EC2220046-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-EC2220046-AI.PDF”.

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--END OF REPORT--